

Original Article

# The financial burden of knee osteoarthritis patients: a study of healthcare costs and expenses

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## Abstract

Knee osteoarthritis (OA) is a highly prevalent disease among the elderly population that results in joint degeneration, leading to reduced mobility and challenging daily living. Patients can choose from various treatment options depending on the stage of joint degeneration. In developing countries such as Pakistan, it is crucial to comprehend the financial burden borne by patients and their families due to this condition's high prevalence. Therefore, this exploratory study aimed to assess the financial burden of knee OA patients seeking healthcare services by analyzing the healthcare costs and expenses incurred by them. A purposive sampling technique was employed to recruit 112 knee OA patients undergoing any treatment modality from public and private hospitals in Lahore. A semistructured questionnaire collected patients' sociodemographic information and overall out-of-pocket health expenditures. Descriptive statistics and the Mann-Whitney U test were utilized for data analysis. The patients' mean age was  $53.69 \pm 11.73$  years, with  $10.26 \pm 4.83$  years of education. Stage III knee OA was the most common diagnosis (30.36%), followed by stage IV (28.57%), stage II (22.32%), and stage I (18.75%). The direct medical cost was significantly higher [United States dollars (USD) 2,590.97] among patients who underwent surgery than among those who opted for alternative treatment procedures (USD 192.10) ( $p = 0.001$ ). Similarly, the indirect medical cost was significantly higher (USD 371.75) among patients who underwent surgery than among those who chose other treatment options (USD 23.66) ( $p = 0.001$ ). The overall cost of illness was 6.02 times higher among patients who had surgery (USD 3,050.93) than among those who opted for other treatment modalities (USD 507.19) ( $p = 0.001$ ). The study's findings provide insights into the financial burden borne by knee OA patients' families, emphasizing the need for policymakers to intervene. By understanding the costs of illness borne by patients and their families, policymakers can develop targeted interventions to alleviate the financial burden and improve access to healthcare services for knee OA patients.

## Keywords

Health expenditures; Out-of-pocket costs; Knee osteoarthritis; Knee replacement; Healthcare costs

## 1. Introduction

Osteoarthritis (OA) is a degenerative joint disease arising from cartilage wear and tear at the edge of the bones, resulting in inflammation, pain, and reduced movement of the joint [1, 2]. The symptoms of OA include joint stiffness, tenderness, severe pain, joint swelling, restricted joint movement, snapping sounds, and muscular atrophy [3]. OA mainly affects the different joints, including the knee, hand, and hip joints [4].

Total knee arthroplasty (TKA) is the standardized treatment for late stages of knee OA worldwide [5]. It is a unicompartamental polycentric knee arthroplasty performed among patients with any or both compromised knee joints and a significant level of dam-

age where total knee replacement or conventional reconstruction is not favorable [6]. Patients with OA can opt for knee replacement surgery, which is contraindicated in cases of necrosis, condylar fracture, tibial plateau prosthesis, osteotomy procedure failure, and valgus upper tibial osteotomy [7]. TKA is a cost-effective treatment modality that improves joint functioning among patients with advanced stages of knee OA [8]. It also plays a vital role in alleviating pain, with a high proportion of success in managing this disease [8].

Globally, knee OA is most prevalent among the elderly because the degeneration of joints leads to reduced movements and makes daily living difficult [9]. Gender differences in patients with knee OA are well documented. The male population is more likely to suffer from knee OA above 60, whereas the female population of the same age group suffers from both knee OA [10]. The prevalence of knee OA in Europe and North America is 0.19% and 0.25%, respectively [11]. A study reported that nearly one million total knee and hip joint replacement procedures are performed annually in the United States (US), underlining the country's high incidence of joint replacement procedures [12]. In the United Kingdom (UK), the lifetime morbidity of OA is approximately 45% for knees, whereas 57,000 knee replacement surgeries are performed yearly [13]. In contrast, the prevalence of knee OA is high in South Asian countries, varying between 1.42% and 83.73% [14]. The country profile of low- and middle-income countries (LMICs) further clarifies the situation where India (28.7%), Pakistan (25.00% in rural and 28.00% in urban areas), and Bangladesh (10.20%) reported a high prevalence of knee OA among the general population [15, 16]. According to data from 2010 to 2017, the prevalence of OA increased in South Africa by 9%, Brazil by 14%, and Nepal by 20% [17]. In addition, the pooled prevalence of OA in various regions was reported as 16.4% in South Asia, 15.7% in East Asia and the Pacific, and 14.2% in Sub-Saharan Africa [14].

The US-based study found that the average lifetime cost of care borne by knee OA patients is contingent on the eligibility for TKA for the various Kellgren–Lawrence grades and ranges between United States dollars (USD) 12,400 and USD 16,000 [18]. Bedenbaugh et al. compared the cost of illness spent by US knee OA patients and controls [19]. The knee OA cohort spent a significantly high amount on outpatient visits (USD 12,571) and pharmacy claims (USD 3,655) compared to their controls, with an accumulated all-cause average cost of USD 24,550. In Pakistan, the financial burden of TKA is also overwhelmingly high. A local study reported that patients who have undergone bilateral TKA surgery in a private healthcare facility spent an overall cost of USD 4,360.51, consisting of human resource costs (USD 524.44), consumable costs (USD 3,737.49), and overhead costs (USD 98.58) [20].

The economic condition of a country is closely linked to the poverty of both rural and urban populations. Simultaneously, medical conditions directly affect the overall financial condition of a household. For example, according to the Asian Development Bank (ADB), 21.9% of the population lives below the national poverty line in Pakistan, and nearly 3.7% of the employed population has purchasing power parity a day below USD 1.90, which barely allows a family to meet the expenditures of households [21]. In this situation, people contracting lethal diseases such as OA affect their overall domestic spending and quality of life [22, 23]. Therefore, it is crucial to determine the financial burden of knee OA to understand the extent of expenditure borne by the patients either out of pocket or by paying the subsidized cost for various outlays, such as the cost of medicines, injections, surgery, consultation fees, etc. Therefore, this study assessed the financial burden of knee OA patients seeking healthcare services by assessing the healthcare costs and expenses incurred by these patients. The study aims to provide in-

sights into the costs associated with this condition and the financial challenges that patients and their families may face when seeking healthcare services.

## 2. Materials and methods

The present study is an exploratory investigation that was conducted over a period of five months, from April to August 2021. Data for this study were collected from three hospitals located in Lahore, which is a densely populated district in Punjab Province. The hospitals included in the study were Jinnah Hospital, Hussain Memorial Hospital, and Iffat Anwar Medical Complex, which comprise both public and private institutions with inpatient, outpatient, and physical therapy departments. The researcher obtained administrative approval from all the hospitals mentioned above and acquired ethical clearance from the Ethics Review Committee of Hussain Memorial Hospital, Lahore, Pakistan (No. HMMH/RC/2021/03).

All eligible participants for this study were individuals aged between 35 and 85 years who had a confirmed diagnosis of knee OA and had received any form of treatment for the condition for at least three months and up to two years at the time of data collection. Any individuals who did not provide written informed consent were excluded from the study. Before the face-to-face interviews, all participants were provided with information leaflets in Urdu's local language detailing the study's objectives and purpose. In addition, oral explanation was provided to those who were illiterate.

The study employed a purposive sampling technique, a type of nonprobability sampling method, to recruit 112 knee OA patients. A semistructured questionnaire was used to gather patients' sociodemographic information and their families' overall out-of-pocket health expenditures. The expenses were categorized as direct medical costs (such as general practitioner fees, consultant fees, laboratory charges, surgery, injections, medicines, and physical therapy costs), direct nonmedical costs (including hospital accommodation, food, and transportation charges), and indirect nonmedical costs (such as home help, children tuition services, and other expenses) based on the World Health Organization (WHO) guidelines [24, 25]. The collected costs were summed to obtain the overall cost of illness. The study estimated the average cost incurred by each patient for their knee OA treatment during the entire study duration and did not calculate it on an annual or monthly basis. All the cost elements were recorded in Pakistani rupees (PKR) and later converted into USD at an average exchange rate of 2021, which was (USD 1 = PKR 162.97) [26].

The collected data were analyzed using Statistical Package for Social Sciences (SPSS) version 25.00. Frequencies, percentages, means, medians, and standard deviations (SDs) were calculated to achieve the study's objectives. To compare the elements of the cost of illness between patients who underwent surgery and those who opted for other treatment options, the Mann-Whitney U test was used, and  $p < 0.05$  was considered statistically significant.

## 3. Results

Table 1 presents the demographic and clinical characteristics of the 112 knee OA patients included in the study. Most patients were female (76.79%), while 23.21% were male. The mean age of the patients was  $53.69 \pm 11.73$  years, and the average education was  $10.26 \pm 4.83$  years. The reported annual household income was USD  $4,370.94 \pm 1,780.97$ . Furthermore, approximately 62.50% of the patients had a family history of knee OA. Of the 112 patients, stage III knee OA was the most common diagnosis (30.36%), followed by stage IV (28.57%), stage II (22.32%), and stage I (18.75%). On average, patients had been diagnosed with knee OA for  $28.75 \pm 40.87$  months.

**Table 1.** Demographic and clinical characteristics of knee OA patients (n = 112).

| Demographics and Clinical Characteristics                 |           | N (%)       | Mean ± SD           |
|---|-----------|-------------|---------------------|
| Age (in years)  |           | -           | 53.69 ± 11.73       |
| Gender  | Male      | 26 (23.21)  | -                   |
|   | Female    | 86 (76.79)  | -                   |
| Marital status  | Married   | 110 (98.21) | -                   |
|   | Unmarried | 2 (1.79)    | -                   |
| Education (in years)                                      |           | -           | 10.26 ± 4.83        |
| Family members (in numbers)                               |           | -           | 6.71 ± 1.90         |
| Annual household income (in USD)                          |           | -           | 4,370.94 ± 1,780.97 |
| Family history of knee OA                                 | Yes       | 70 (62.50)  | -                   |
|   | No        | 42 (37.50)  | -                   |
| Stage of knee OA  | Stage I   | 21 (18.75)  | -                   |
|   | Stage II  | 25 (22.32)  | -                   |
|   | Stage III | 34 (30.36)  | -                   |
|   | Stage IV  | 32 (28.57)  | -                   |
| Initiation of knee OA symptoms till diagnosis (in months) |           | -           | 45.23 ± 47.75       |
| Knee OA diagnosis (in months)                             |           | -           | 28.75 ± 40.87       |

**Table 2.** Cost of illness borne by knee OA patients in USD (n = 112).

| Variables                  | With Surgery<br>n = 16 |                                | Without Surgery<br>n = 96 |                          | p value * |
|----------------------------|------------------------|--------------------------------|---------------------------|--------------------------|-----------|
|                            | Mean ± SD              | Median (IQR)                   | Mean ± SD                 | Median (IQR)             |           |
| Direct Medical Costs       |                        |                                |                           |                          |           |
| General practitioner       | 21.52 ± 18.43          | 24.54 (1.77 – 30.68)           | 20.43 ± 75.53             | 0.00 (0.00 – 11.50)      | 0.001 **  |
| Consultant                 | 7.25 ± 5.89            | 9.20 (1.23 – 9.20)             | 11.93 ± 29.52             | 9.20 (1.23 – 9.20)       | 0.943     |
| Laboratory                 | 28.76 ± 31.24          | 10.74 (6.74 – 55.23)           | 11.94 ± 15.95             | 6.14 (3.07 – 12.27)      | 0.004 **  |
| Surgery                    | 2,055.59 ± 1,328.58    | 1,380.62 (1,227.22 – 2,914.65) | -                         | -                        | -         |
| Injections                 | 23.93 ± 41.06          | 1.84 (0.00 – 34.67)            | 11.68 ± 54.48             | 0.00 (0.00 – 0.00)       | 0.001 **  |
| Medicines                  | 174.72 ± 411.40        | 24.54 (6.91 – 62.13)           | 71.22 ± 189.61            | 24.54 (9.66 – 45.25)     | 0.887     |
| Physical therapy           | 279.19 ± 147.92        | 230.10 (142.66 – 451.00)       | 64.90 ± 61.02             | 42.95 (18.41 – 85.91)    | 0.001 **  |
| Direct Medical Cost        | 2,590.97 ± 1,402.56    | 2,277.11 (1,551.05 – 3363.81)  | 192.10 ± 267.71           | 130.40 (51.09 – 203.72)  | 0.001 **  |
| Indirect Medical Costs     |                        |                                |                           |                          |           |
| Hospital accommodation     | 234.71 ± 196.89        | 196.36 (41.42 – 444.87)        | 0.00 ± 0.00               | 0.00 (0.00 – 0.00)       | 0.001 **  |
| Food                       | 52.92 ± 84.19          | 18.41 (0.00 – 69.03)           | 1.02 ± 5.62               | 0.00 (0.00 – 0.00)       | 0.001 **  |
| Transportation             | 84.12 ± 58.72          | 88.98 (27.15 – 108.92)         | 22.64 ± 17.32             | 18.41 (12.27 – 27.61)    | 0.001 **  |
| Indirect medical cost      | 371.75 ± 247.60        | 323.68 (171.35 – 607.48)       | 23.66 ± 18.86             | 18.41 (12.27 – 27.61)    | 0.001 **  |
| Indirect Non-Medical Costs |                        |                                |                           |                          |           |
| Home help (maid etc.)      | 34.52 ± 28.33          | 30.68 (13.81 – 53.69)          | 11.66 ± 18.35             | 0.00 (0.00 – 18.41)      | 0.001 **  |
| Children tuition services  | 7.67 ± 20.96           | 0.00 (0.00 – 0.00)             | 274.85 ± 564.92           | 116.59 (0.00 – 306.80)   | 0.001 **  |
| Other expenses             | 46.02 ± 69.06          | 0.00 (0.00 – 0.00)             | 4.92 ± 21.76              | 0.00 (0.00 – 0.00)       | 0.001 **  |
| Indirect nonmedical costs  | 88.21 ± 85.61          | 61.36 (13.81 – 191.75)         | 291.43 ± 583.90           | 116.59 (24.54 – 306.80)  | 0.129     |
| Overall Cost of Illness    |                        |                                |                           |                          |           |
| The total cost of illness  | 3,050.93 ± 1,378.37    | 2,876.30 (2,058.20 – 4,032.64) | 507.19 ± 655.36           | 306.50 (173.81 – 481.38) | 0.001 **  |

\* All cost categories are compared using the Mann-Whitney U test. \*\* Significant at  $p < 0.05$ .

Table 2 compares the different components of healthcare costs between knee OA patients who underwent surgery and those who opted for alternative treatment procedures. Patients who underwent surgery had significantly higher direct medical costs (USD 2,590.97) than those who opted for alternative treatment procedures (USD 192.10), with the surgery cost being the major contributor (USD 2,055.59) to this difference ( $p =$

0.001). Indirect medical costs were also significantly higher among patients who underwent surgery (USD 371.75) than among those who opted for other treatment options (USD 23.66) ( $p = 0.001$ ). On the other hand, overall indirect nonmedical costs were higher among patients who opted for alternative treatment methods (USD 291.43) than among those who underwent surgery (USD 88.21), but this difference was not statistically significant ( $p = 0.129$ ). The study found that the overall cost of illness was 6.02 times higher among patients who underwent surgery (USD 3,050.93) than among those who opted for alternative treatment options (USD 507.19), and this difference was statistically significant ( $p = 0.001$ ).

#### 4. Discussion

Our study showed that the proportion of female patients was higher than that of male patients, and nearly two-thirds had a family history of knee OA. Additionally, most patients were diagnosed with stage III and stage IV knee OA. Patients who underwent surgery had significantly higher direct medical costs, with surgery being the major contributor to this cost. Indirect medical costs were also higher for patients who had surgery. However, the indirect nonmedical costs were higher for patients who opted for alternative treatment methods, although this difference was not statistically significant. Overall, the cost of illness was much higher for patients who underwent surgery than for those who chose alternative treatment options.

The US-based study assessed the lifetime medical care cost borne by knee OA patients [27]. In line with our study results, the study reported that the average cost of illness of symptomatic knee OA was high (i.e., USD 12,400) per person [27]. Furthermore, the results of another study conducted in the Netherlands align with our results that highlighted that total knee-related productivity costs and medical costs of conservative treatment of symptomatic knee OA among patients with paid employment were €871 per patient per month, including 83% productivity costs and 17% medical costs [28].

A systematic review included multiregional studies to assess variation in different aspects of the costs of knee OA from a larger perspective [29]. The overall costs for topical and oral nonsteroidal anti-inflammatory drugs (NSAIDs) were approximately 19.2 and 25.65 million pounds, respectively. Moreover, knee and hip replacement surgeries exceeded 850 million pounds, and knee OA surgery cost approximately 1.34 million pounds. Indirect costs from OA caused economic production losses of approximately 3.2 billion pounds, 43 million pounds in community services expenditures, and 215 million pounds for social services [29]. Another French study supports our study's results, which highlighted that the direct medical cost of knee OA was more than 1.6 billion Euros in the country and accounted for approximately 1.7% of the expenses of the French health insurance system [30]. In addition, hospitalization was the single major contributor to direct costs, with more than 800 million Euros.

Multiple nonoperative treatment methods can reduce the cost of knee OA by 45%, which the American Academy of Orthopedics also suggests through its clinical guidelines [31]. Another study revealed that 16.6% of participants received a hyaluronic acid injection, and 12.9% had knee arthroplasty during the study period. For patients who received hyaluronic acid injections following knee arthroplasty, hyaluronic acid injection contributed 1.8%, while knee arthroplasty contributed 76.6% to the overall costs of knee OA. In addition, patients who only received hyaluronic acid injections incurred less than 10% of the knee OA-related costs compared with patients who had undergone surgery [31]. Another study assessed the cost-effectiveness of knee OA and highlighted that the cost of illness within the two-year follow-up was approximately 4.99 billion dollars, of which 69% of costs were attributed to 3.2% of knee OA patients who had undergone surgery [18].



On the other hand, 15.9% of patients opted for low-cost interventions such as hyaluronic acid injections, contributing 1.7% to the overall cost of illness. However, 84.1% of patients who opted for nonsurgical treatment saved an average of USD 20,740 per patient [18].

OA is a degenerative joint disease for which pharmacological management is comparatively cheaper but somewhat ineffective. Therefore, most patients later opt for surgical intervention, which is expensive and ultimately increases the cost of the treatment [32, 33]. Furthermore, it is evident from the literature that patients wait for years and rely on pain relief medications until unbearable pain increases the level of disability [34, 35]. The prolonged usage of medication and undergoing surgical procedures add significantly to the cost of illness. The high treatment cost may also be attributed to the cost of alternative therapies experienced by knee OA patients for a longer duration that only accounts for symptomatic treatment but not a proper cure [36, 37]. According to an estimate, patients may use pharmacological and nonconventional therapies other than surgery for 20 years, which utilizes healthcare resources and increases the cost of illness [38, 39]. Although surgery seems to be an expensive intervention considering the duration, severity, and level of disability of OA, compared to long-term medication use, pain relief, and mobility, it has proven cost-effective in curing knee OA [40, 41].

The study determined the financial impact of knee OA treatment in the local context of developing countries such as Pakistan, which is one of the key public health issues, and has added baseline information to the literature, which is the potential strength of this study. However, the study only considered knee OA among all other types of OA. In addition, it was conducted by only including the noncomplicated cases, which marks a weakness of the study.

This study was subject to two limitations. First, the study was limited to one public and two private hospitals, which may have influenced the results and limited the generalizability of the findings. Second, we included patients who had been experiencing any treatment modalities for knee osteoarthritis for a minimum of three months and a maximum of two years at the time of the interview. This approach may have excluded patients in the early stages of the disease or who have been receiving treatment for longer periods, which may limit the generalizability of our findings. Additionally, our study may not have captured the long-term treatment effects of knee osteoarthritis, which may have important implications for the financial burden experienced by patients. Therefore, the generalizability of our results should be interpreted with caution, particularly for patients with different treatment durations or disease stages.

## 5. Conclusions

The study highlights the significant financial burden faced by knee OA patients and their families, particularly those from low-income households, due to the combination of direct and indirect medical costs. The findings emphasize the pressing need for policymakers to intervene to alleviate the short-term financial consequences and enhance households' short- and long-term fiscal health. The study underscores the importance of recognizing the financial implications of knee OA treatment and the potential long-term consequences. It is crucial to take urgent action to reduce the burden and increase the accessibility and affordability of treatment options, particularly for low-income households. Therefore, the findings of this study have important implications for policymakers and stakeholders in developing targeted interventions to alleviate the financial burden and improve access to healthcare services for knee OA patients.

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**Ethics statement:** The study obtained ethical clearance from the Ethics Review Committee of Hussain Memorial Hospital, Lahore, Pakistan (No. HMH/RC/2021/03).

**Consent to participate:** Informed consent was obtained from all patients included in the study.

**Data availability:** The data supporting this study's findings are available from the corresponding author, Rooha, upon reasonable request.

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## References

- [1] Loeser RF, Goldring SR, Scanzello CR, Goldring MB. Osteoarthritis: A disease of the joint as an organ. *Arthritis Rheum.* 2012;64(6):1697-707. <https://doi.org/10.1002/art.34453>
- [2] Taj Din S, Tayaba H. A comparison of health-related quality of life among knee osteoarthritis patients in two cities in Pakistan. *Clin Surg Res Commun.* 2019;3(4):20-5. <https://doi.org/10.31491/CSRC.2019.12.040>
- [3] Kean WF, Kean R, Buchanan WW. Osteoarthritis: Symptoms, signs and source of pain. *Inflammopharmacology.* 2004;12:3-31. <https://doi.org/10.1163/156856004773121347>
- [4] Hunter DJ, McDougall JJ, Keefe FJ. The symptoms of osteoarthritis and the genesis of pain. *Rheum Dis Clin North Am.* 2008;34(3):623-43. <https://doi.org/10.1016/j.rdc.2008.05.004>
- [5] Kane RL, Saleh KJ, Wilt TJ, Bershadsky B, Cross 3rd WW, MacDonald RM, et al. Total knee replacement. *Evid Rep Technol Assess (Summ).* 2003;(86):1-8.
- [6] Skolnick MD, Bryan RS, Peterson LF. Unicompartamental polycentric knee arthroplasty: Description and preliminary results. *Clin Orthop Relat Res.* 1975;(112):208-14.
- [7] Wilcox PG, Jackson DW. Unicompartamental knee arthroplasty. *Orthop Rev.* 1986;15(8):490-5.
- [8] Bozic KJ, Kurtz SM, Lau E, Ong K, Chiu V, Vail TP, et al. The epidemiology of revision total knee arthroplasty in the United States. *Clin Orthop Relat Res.* 2010;468(1):45-51. <https://doi.org/10.1007/s11999-009-0945-0>
- [9] Hurley M, Dickson K, Hallett R, Grant R, Hauari H, Walsh N, et al. Exercise interventions and patient beliefs for people with hip, knee or hip and knee osteoarthritis: A mixed methods review. *Cochrane Database Syst Rev.* 2018;4(4): CD010842. <https://doi.org/10.1002/14651858.CD010842.pub2>
- [10] Michael JW, Schlüter-Brust KU, Eysel P. The epidemiology, etiology, diagnosis, and treatment of osteoarthritis of the knee. *Dtsch Arztebl Int.* 2010;107(9):152-62. <https://doi.org/10.3238/arztebl.2010.0152>
- [11] Gore M, Tai KS, Sadosky A, Leslie D, Stacey BR. Clinical comorbidities, treatment patterns, and direct medical costs of patients with osteoarthritis in usual care: A retrospective claims database analysis. *J Med Econ.* 2011;14(4):497-507. <https://doi.org/10.3111/13696998.2011.594347>
- [12] Kremers HM, Larson DR, Crowson CS, Kremers WK, Washington RE, Steiner CA, et al. Prevalence of total hip and knee replacement in the United States. *J Bone Joint Surg Am.* 2015;97(17):1386-97. <https://doi.org/10.2106/JBJS.N.01141>
- [13] Cooper C, Arden NK. Excess mortality in osteoarthritis. *BMJ.* 2011;342:d1407. <https://doi.org/10.1136/bmj.d1407>
- [14] Yahaya I, Wright T, Babatunde OO, Corp N, Helliwell T, Dikomitil L, et al. Prevalence of osteoarthritis in lower middle-and low-income countries: A systematic review and meta-analysis. *Rheumatol Int.* 2021;41:1221-31. <https://doi.org/10.1007/s00296-021-04838-y>
- [15] Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. Epidemiology of knee osteoarthritis in India and related factors. *Indian J Orthop.* 2016;50:518-22. <https://doi.org/10.4103/0019-5413.189608>
- [16] Iqbal MN, Haidri FR, Motiani B, Mannan A. Frequency of factors associated with knee osteoarthritis. *J Pak Med Assoc.* 2011;61(8):786-9.
- [17] Safiri S, Kolahi AA, Smith E, Hill C, Bettampadi D, Mansournia MA, et al. Global, regional and national burden of osteoarthritis 1990-2017: A systematic analysis of the Global Burden of Disease Study 2017. *Ann Rheum Dis.* 2020;79(6):819-28. <https://doi.org/10.1136/annrheumdis-2019-216515>
- [18] Ong KL, Runa M, Lau E, Altman RD. Cost-of-illness of knee osteoarthritis: Potential cost savings by not undergoing arthroplasty within the first 2 years. *Clinicoecon Outcomes Res.* 2019;11:245-55. <https://doi.org/10.2147/CEOR.S170119>
- [19] Bedenbaugh AV, Bonafede M, Marchlewicz EH, Lee V, Tambiah J. Real-world health care resource utilization and costs among US patients with knee osteoarthritis compared with controls. *Clinicoecon Outcomes Res.* 2021;13:421-35. <https://doi.org/10.2147/CEOR.S302289>
- [20] Khan RM, Albutt K, Qureshi MA, Ansari Z, Drevin G, Mukhopadhyay S, et al. Time-driven activity-based costing of total knee replacements in Karachi, Pakistan. *BMJ Open.* 2019;9(5):e025258. <https://doi.org/10.1136/bmjopen-2018-025258>
- [21] Asian Development Bank. Poverty Data: Pakistan. 2022 [cited 09 July 2022]. Available from: <https://www.adb.org/countries/pakistan/poverty>.

- [22] Anwar T, Qureshi SK, Ali H. Landlessness and rural poverty in Pakistan. *Pak Dev Rev.* 2004;43(4):855-74. <https://doi.org/10.30541/v43i4Ipp.855-874>
- [23] The World Bank. Out-of-pocket expenditure (% of current health expenditure) – Pakistan. 2022 [cited 09 July 2022]. Available from: <https://data.worldbank.org/indicator/SH.XPD.OOPC.CH.ZS?locations=PK>.
- [24] Mahmood HZ, Khaliq IH, Iqbal Bhatti Z, J Wilson K, Gondal KM, Malik S, et al. Household costs of breast cancer morbidity: An empirical assessment from Pakistan. *J BUON.* 2018;23(Suppl 1):S28-33.
- [25] World Health Organization. WHO guide to identifying the economic consequences of disease and injury. Geneva (GE): World Health Organization; 2009.
- [26] Exchange Rates UK. US Dollar to Pakistani Rupee Spot Exchange Rates for 2021. 2022 [cited 09 July 2022]. Available from: <https://www.exchangerates.org.uk/USD-PKR-spot-exchange-rates-history-2021.html>.
- [27] Losina E, Paltiel AD, Weinstein AM, Yelin E, Hunter DJ, Chen SP, et al. Lifetime medical costs of knee osteoarthritis management in the United States: Impact of extending indications for total knee arthroplasty. *Arthritis Care Res.* 2015;67(2):203-15. <https://doi.org/10.1002/acr.22412>
- [28] Stan G, Orban H, Orban C. Cost effectiveness analysis of knee osteoarthritis treatment. *Chirurgia.* 2015;110(4):368-74.
- [29] Chen A, Gupte C, Akhtar K, Smith P, Cobb J. The global economic cost of osteoarthritis: How the UK compares. *Arthritis.* 2012; 2012:698709. <https://doi.org/10.1155/2012/698709>
- [30] Le Pen C, Reygrobelle C, Gérentes I. Financial cost of osteoarthritis in France: The “COART” France study. *Joint Bone Spine.* 2005;72(6):567-70. <https://doi.org/10.1016/j.jbspin.2005.01.011>
- [31] Malanga G, Niazi F, Kidd VD, Lau E, Kurtz SM, Ong KL, et al. Knee osteoarthritis treatment costs in the medicare patient population. *Am Health Drug Benefits.* 2020;13(4):144-53.
- [32] Hawker GA, Guan J, Croxford R, Coyte PC, Glazier RH, Harvey BJ, et al. A prospective population-based study of the predictors of undergoing total joint arthroplasty. *Arthritis Rheum.* 2006;54(10):3212-20. <https://doi.org/10.1002/art.22146>
- [33] Azar FM. Knee and global perspectives in orthopedic surgery. *Orthop Clin.* 2020;51(2):ix-xiii. [https://doi.org/10.1016/S0030-5898\(20\)30008-0](https://doi.org/10.1016/S0030-5898(20)30008-0)
- [34] Kapstad H, Hanestad BR, Langeland N, Rustøen T, Stavem K. Cutpoints for mild, moderate and severe pain in patients with osteoarthritis of the hip or knee ready for joint replacement surgery. *BMC Musculoskelet Disord.* 2008;9:55. <https://doi.org/10.1186/1471-2474-9-55>
- [35] Agarwala V, Sipani AK, Sarkar L. A clinical study on management of medial compartment knee osteoarthritis by proximal fibular osteotomy. *Int J Orthop.* 2020;6(1):1296-9. <https://doi.org/10.22271/ortho.2020.v6.i1r.2000>
- [36] Kamaruzaman H, Kinghorn P, Oppong R. Cost-effectiveness of surgical interventions for the management of osteoarthritis: A systematic review of the literature. *BMC Musculoskelet Disord.* 2017;18:183. <https://doi.org/10.1186/s12891-017-1540-2>
- [37] Riaz R, Althomali OW, Sultana B, Amjad I, Abbas S, Khan N. Effectiveness of lateral wedge insole on knee osteoarthritis outcomes in pakistani population. *Rehabil J.* 2022;6(02):361-6. <https://doi.org/10.52567/trj.v6i02.174>
- [38] Qvist P, Bay-Jensen AC, Christiansen C, Dam EB, Pastoureau P, Karsdal MA. The disease modifying osteoarthritis drug (DMOAD): Is it in the horizon?. *Pharmacol Res.* 2008;58(1):1-7. <https://doi.org/10.1016/j.phrs.2008.06.001>
- [39] Ahmad K, Ali L, Maan MAM. The effects of injecting intra articular platelet-rich plasma on pain scores in knee joint osteoarthritis. *Pak Armed Forces Med J.* 2021;71(4):1278-81. <https://doi.org/10.51253/pafmj.v71i4.4791>
- [40] Bedair H, Cha TD, Hansen VJ. Economic benefit to society at large of total knee arthroplasty in younger patients: A Markov analysis. *J Bone Joint Surg Am.* 2014;96(2):119-26. <https://doi.org/10.2106/JBJS.L.01736>
- [41] Pedneault C, St George S, Masri BA. Challenges to implementing total joint replacement programs in developing countries. *Orthop Clin North Am.* 2020;51(2):131-9. <https://doi.org/10.1016/j.ocl.2019.11.001>